



# Los Alamos technologies help scientists detect, record & interpret ‘monster’ burst of gamma rays

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LOS ALAMOS, New Mexico, March 21, 2008—On the ground and in space, Los Alamos National Laboratory’s science tools provided early information on the first gamma ray burst so powerful that it could be seen with the naked eye. The burst was detected March 19 by NASA’s Swift satellite, thanks to software on Swift’s Burst Alert Telescope, which was the first instrument to detect the sudden rise in gamma rays.

Within seconds the Burst Alert Telescope’s software, developed at Los Alamos, had independently determined the gamma rays’ origin, directed telescopes on the ground to point to that location, and commanded the Swift spacecraft to swing around for a closer look, according to David Palmer, the space scientist behind the software. Within a minute of the start of the burst, Swift’s sensitive X-ray and optical telescopes were already gathering more information.

In the mean time, the ground-based Los Alamos RAPTOR robotic telescope system made observations that included measurements of the gamma-ray burst location before the burst and during the exceptionally bright flash, as well as simultaneous multicolor observations of the late phases of the flash and early afterglow. The observations were made with seven different telescopes in the RAPTOR system and provide an unmatched observational record of optical emission from this amazing gamma-ray burst.

“The gamma-ray burst reached a peak apparent magnitude of 5.6 while the gamma rays were being emitted,” said astrophysicist Tom Vestrand. People with normal vision on a dark night can see stars slightly fainter than magnitude 6, and the brighter an object, the lower its magnitude number. Based on measurements of the burst’s redshift radiation the explosion took place 7.5 billion years ago, before the formation of Earth. (Redshift, generally, is the apparent shift toward longer wavelengths of spectral lines, toward the red end of the spectrum, in the radiation emitted by an object. It is caused by the emitting object, such as a star, moving away from the observer.)

On the ground, a teleconference of scientists from all of Swift’s instruments were watching the data arrive in real time. “It’s a monster!” one of them exclaimed. Within 30 minutes a description of the burst titled “GRB 080319B: Swift detection of an intense burst with a bright optical counterpart” was heading toward e-mail inboxes of scientists all over the world.

By this time, instruments all over the world were pointing at the new burst. “Most of the best data was from robotic telescopes--in this business you lose a lot of the best science if you have to wait for a human--and tracks the brilliant flaring of the light from the earliest seconds of the burst,” said Palmer, a Los Alamos astrophysicist with a special expertise in coded-aperture imaging and complex algorithms.

Equipped with sophisticated computer intelligence, RAPTOR is the first robotic observatory system that can find and study on its own transient optical events. It is also the only such system with stereovision, which allows it to discern between transient optical events and nearby space junk, as well as to detect “killer” asteroids.

The RAPTOR system consists of a network of small robotic observatories at Fenton Hill, in the Jemez Mountains west of Los Alamos, and another unit at the Los Alamos Neutron Science Center, 38 miles away. Computers located between the two sites analyze data from the observatories and send commands to computers at the sites that control the observatories’ telescopes and digital cameras. RAPTOR was built by a Los Alamos team headed by Vestrand; the project was funded by the Los Alamos Laboratory Directed Research and Development Program.

Gamma-ray bursts are brief, intense, flashes of gamma ray emission and the most distant ones are now known to signal the birth of a black hole through the cataclysmic collapse of a massive star. Although the intense gamma rays are emitted only during the explosion, the new observations show that visible light is emitted both by the explosions and the glowing embers of surrounding material impacted by the blast.

Swift is managed by Goddard Space Flight Center. It was built and is being operated in collaboration with Penn State, Los Alamos National Laboratory, and General Dynamics in the United States; the University of Leicester and Mullard Space Sciences Laboratory in the United Kingdom; Brera Observatory and the Italian Space Agency in Italy; plus partners in Germany and Japan.

See more about the RAPTOR project at [http://www.lanl.gov/quarterly/q\\_fall03/raptor\\_science.shtml#observatories](http://www.lanl.gov/quarterly/q_fall03/raptor_science.shtml#observatories) online.

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